A survey for threatened herpetofauna of the south-west slopes of New South Wales

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ABSTRACT

Timber production forests and adjacent lands of the south-west slopes of New South Wales were surveyed for frogs and reptiles over three periods during 1994/95. Hand and aural surveys targeted the habitats of eight endangered species known from or considered likely to occur within the region. Eleven species of frog and eighteen species of reptile were located during the survey, but only one of these was a listed threatened species (with another being recorded incidentally after the survey period). However, the presence of suitable habitat indicated that four other threatened species could be present in the area. It is suggested that continued habitat alteration through grazing and agricultural practices may be having the greatest impact on the herpetofauna of the area and that a suitable reserve system is required incorporating known or likely sites for each species. It is recommended that grazing should be phased out of some state forest areas and burning regimes modified to provide a diversity of habitats.

INTRODUCTION

The south-west slopes of New South Wales contain a diversity of habitats ranging from tall moist forests in the upland areas, to more open dry forests on the mid-slopes and open woodlands on its western edge as well as grasslands and riverine forests scattered throughout. For this reason the area has the potential to contain a wide diversity of amphibian and reptile species. However, the area has been relatively neglected by surveyors (Lunney *et al.* 1995) with only two surveys of the region having been published; a wide-ranging survey of the herpetofauna by Caughley and Gall (1985) and an observational study covering reptiles in its western section (Annable 1995). In particular, there is a dearth of information on species of the region which are considered to be endangered or vulnerable under the *Threatened Species Conservation Act 1995* (hereafter referred to as threatened species). Further information on the distribution and abundance of these species would be most beneficial, but the very fact that species are rare means that they are generally not recorded in standard surveys. For example, Caughley and Gall (1985) located 14 species of frogs and 34 species of reptiles, but of these only *Litoria raniformis* (the southern or warty bell frog) is currently listed under the TSC Act. It has only recently declined (Osborne *et al.* 1996) and was apparently still common around the time of that study. Therefore, surveys which are to provide information on threatened species appear to need a different approach.

This paper reports on the results of a survey of frogs and reptiles in the Tumut and Tumbarumba Management Areas (MAs) of the State Forests of NSW (SFNSW). It was one of four surveys carried out in parallel to determine the status of vertebrates in the Tumut and Tumbarumba area, the others being Kavanagh and Stanton (1998), Law *et al.* (1998) and Stanton and Anderson (1998). All surveys were initiated as part of a Fauna Impact Statement (FIS) as required under the *National Parks and Wildlife Act 1974* and specifically aimed to provide records of species currently listed under the TSC Act. Given the expected difficulty in obtaining such records, the study also assessed the suitability and extent of the preferred habitats of these species within the area. This information was then used to assess the likely status of each species within the area and identify processes likely to threaten their survival.

METHODS

Survey area

A detailed description of this study area is provided in Kavanagh and Stanton (1998) and is summarized here. The area covers the south-west slopes and Southern Tablelands extending from Kosciuszko National Park westwards to Wagga Wagga and Albury. The area is steeply dissected and ranges in altitude from 300 to 1 450 metres with rainfall increasing greatly at higher elevations. Nineteen State Forests are located within the area with four (Bago, Maragle, Buccleuch and Woomargarma) being larger than 20 000 ha and the rest less than 4 000 ha. These forests are generally located on steeper and more upland sites with the majority of the mid-elevation and flatter lands having been converted for agriculture. The dominant commercial tree types are *Eucalyptus delegatensis*

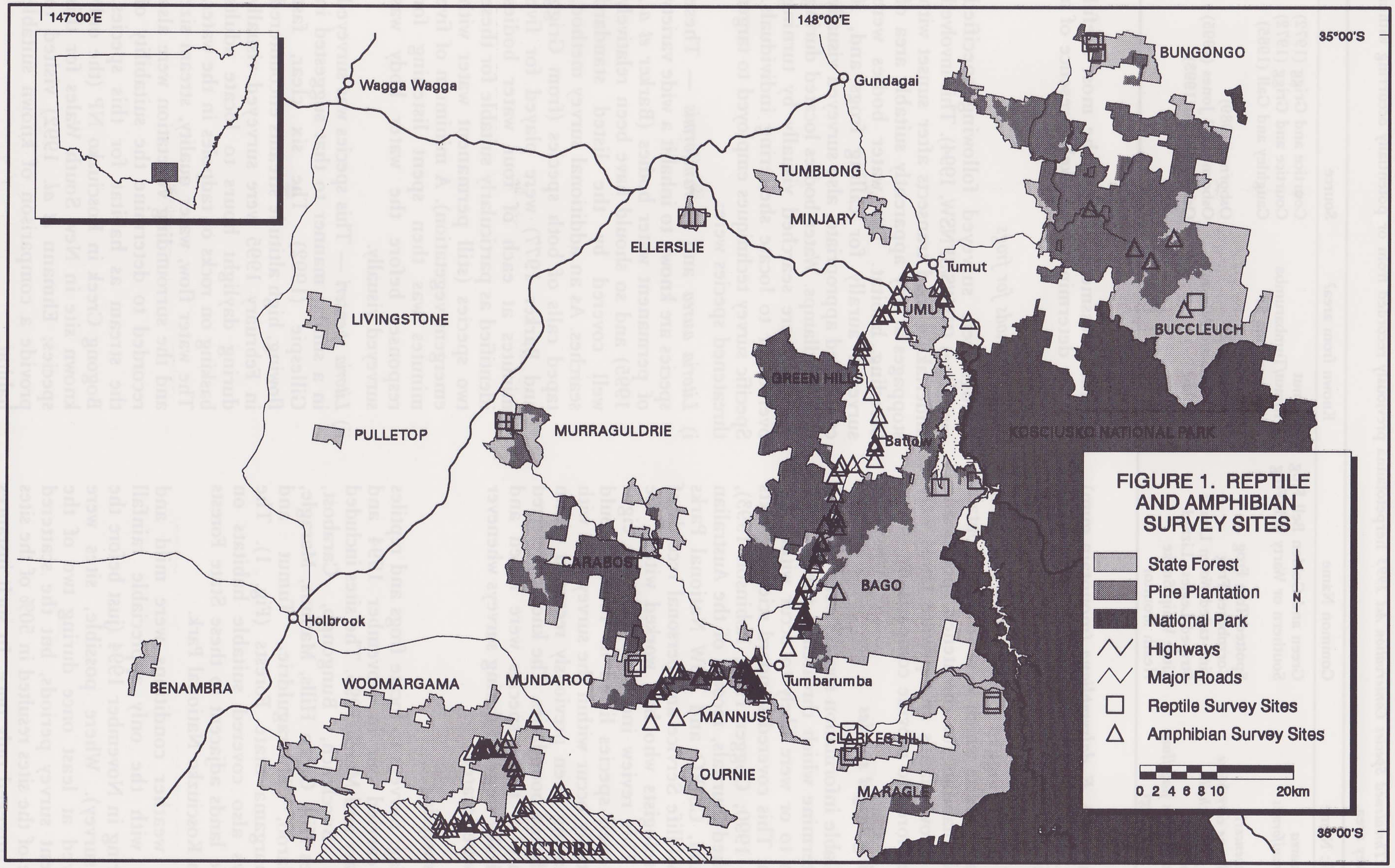

Figure 1. Reptile and amphibian survey sites.

Table 1. Threatened Species Conservation Act 1995 herpetofauna previously recorded from or potentially occurring within the survey area.

Scientific Name	Common Name	Known from area?	Source
Litoria aurea	Green and Golden Bell Frog	Tumut	Courtice and Grigg (1972)
Litoria raniformis	Southern or Warty Bell Frog	Tumut/Tumbarumba Woomargama SF	Courtice and Grigg (1972) Caughley and Gall (1985)
Litoria spenceri	Spotted Tree Frog	No	
Pseudophryne corroboree	Corroboree Frog	Buccleuch SF	Osborne (1989)
Aprasia parapulchella	Pink-tailed Worm Lizard	Tarcuttaand Adelong	Osborne and Jones (1995)
Delma impar	Striped Legless Lizard	Batlow	Osborne *et al.* (1993)
Rhinoplocephalus flagellum	Little Whip Snake	No	
Varanus rosenbergi	Heath Monitor	No	

(Alpine Ash), *E. dalrympliana* (mountain gum) and *E. radiatia* (narrow-leaved peppermint) all of which are located at higher elevations. The lower elevation forests of the west are now rarely if ever logged. Surveys were located in all State Forests which were likely to contain suitable habitats for threatened species and other Crown lands and private lands were also explored to provide comparisons.

Selecting target species

Available information sources were searched to determine which threatened species were known to or were likely to occur within the region. This covered standard scientific texts (Swan 1990; Cogger 1992; Robinson 1993), published journals, records of the Australian Museum, CSIRO and NSW National Parks and Wildlife Service and personal records of herpetologists who had worked within the area. This review indicated that the eight threatened species listed in Table 1 could potentially occur within the survey area with five having been previously recorded within the selected boundaries. The known preferred habitats of these species were noted and specifically targeted during surveys whenever they were located.

Field sampling

Timing: Surveys to locate frogs and reptiles were carried out in November 1994 and February and March 1995. The sites included Bago, Buccleuch, Bungongo, Carabost, Clarkes Hill, Green Hills, Mannus, Maragle, Mundaroo, Murraguldrie, Tumut and Woomargama State Forests (Fig. 1). The surveys also covered suitable habitats on private lands adjacent to these State Forests and in Kosciuzko National Park.

The weather conditions were mild and sunny with the only appreciable rainfall occurring in November 1994 (just before the first survey). Where possible, sites were surveyed at least once during two of the different survey periods, but the scattered nature of the sites resulted in 50% of the sites being surveyed only once. In such instances habitat assessment became the most useful tool for determining the likely presence of a species.

Survey methods for frogs

Frogs were surveyed following specified guidelines (NPWS/SFNSW, 1994). This involved undertaking road transects after sunset with stoppages at any apparently suitable area of breeding habitat. The water bodies were surveyed aurally for calling frogs and, if considered appropriate, also surveyed visually with headlamps. Water bodies located during the day were searched visually by turning over cover to locate sheltering individuals. Specific survey techniques employed to target threatened species were:

i) *Litoria aurea* and *L. raniformis* — These species are known to inhabit a wide variety of permanent water bodies (Barker *et al.* 1995) and so should have been relatively well covered by the listed standard searches. As an additional survey method, taped calls of both species (from Grigg and Barker 1977) were played for five minutes at each of four water bodies identified as particularly suitable for these two species (still permanent water with emergent vegetation). A minimum of five minutes was then spent listening for responses before the water body was surveyed visually.

ii) *Litoria spenceri* — This species was surveyed in a similar manner to that suggested in Gillespie (1992). The six clear, fast flowing, high altitude streams encountered in February 1995 were surveyed visually during daylight hours to locate adults basking on rocks or tadpoles in the water. The water flow, water quality, stream size and the surrounding vegetation were also recorded to determine the suitability of the stream as habitat for this species. Bogong Creek in Kosciuzko NP (the only known site in New South Wales for this species; Ehmann *et al.* 1992) visited to provide a comparison of known suitable habitat.

iii) *Pseudophryne corroboree* — Surveys for this species were carried during February 1995 when this species was known to be calling at monitored sites in Buccleuch State Forest. All swampy sites encountered in highland areas were surveyed using an initial five minute period spent listening for calls. This was followed by a minimum of ten "shouts" (yelling "HOY" as loudly as possible) to elicit territorial responses from any resident males. Additionally, any woody debris located in or around surveyed swamps were turned over and visually inspected in order to detect frogs sheltering beneath or inside them. Surveys specific for this species was carried out at a total of fourteen apparently suitable sites. Intensive surveys of Buccleuch State Forest were not carried out for this species as it is already the subject of an ongoing survey and monitoring programme by State Forests of NSW (B. Gay, pers. comm.).

In total, 40 person hours were spent undertaking nocturnal survey work in the area (15 hours driving roads and 25 person hours of water body survey) covering 106 pond, dam, swamp or pool sites and 46 stream sites. An additional nine person hours were spent during daytime surveys of four dam, twelve stream and five swamp sites. The location of these sites within the FIS Area are shown in Figure 1.

Survey methods for reptiles

Surveys for reptiles also followed the recommendations of NPWS/SFNSW (1994). Initially staff from Tumbarumba District of State Forests were consulted to provide local knowledge of the survey area and indicate areas of potentially important habitat. These areas were then inspected to determine if habitats suitable for any of the threatened species were present and, if so, these were then targeted for survey. Specific methods used for the listed threatened reptiles were:

i) *Aprasia parapulchella* — This species is most often associated with rocky native grassland where *Themeda australis* (kangaroo grass) is dominant with individuals sheltering under small to medium sized rocks (Osborne and Jones 1995). When such areas were located they were surveyed by turning over as many suitable rocks as possible. Seventeen rocky sites were surveyed in this manner.

ii) *Delma impar* — Areas dominated by native grasses (particularly *Themeda*) were surveyed by traversing the site on foot. It was recognized that pitfall trapping is the preferred survey method for this species (used in studies such as Coulson 1990 and Kukolic *et al.* 1994), but time constraints did not allow such methods on this occasion and foot surveys will sometimes obtain records of this species (Coulson 1990; Kukolic and Osborne 1993). In this case those same sites as found for *Aprasia parapulchella* provided adjacent areas of suitable habitat for the striped legless lizard and were surveyed at the same time. More emphasis was placed on locating and recording the position and extent of high quality habitat to provide an assessment of the likelihood of this species being present within the FIS Area. Five person hours were spent on such surveys.

iii) *Rhinoplocephalus flagellum* — Rock outcrops in lightly wooded and cleared areas were hand searched in an attempt to locate this species. At least 45 person minutes were spent searching at each of 20 sites considered suitable for this species.

iv) *Varanus rosenbenbergi* — This species is wide ranging through various habitats and no specific habitat surveys were attempted. Instead, driving roads and covering as large an area as possible appears to offer the greatest chance to detect this species as it has been regularly recorded in the Canberra area in this way (J. Wombey, pers. comm.).

In total 49 person hours were spent on daytime surveys either as driving roads or on actual foot surveys. Eighteen rock outcrops (11.5 person hours) and thirteen woodland areas (for 5.5 person hours) were surveyed during this time (Fig. 1). The location of all sites and individuals were recorded to the nearest 50 m along with environmental conditions at the time of the search and notes on the surrounding habitat.

RESULTS

Frogs

Eleven species were recorded during the survey (Table 2). Of these, only *Pseudophryne corroboree* is a threatened species. It was located at three sites from which it has previously been recorded (B. Gay, pers. comm.) in Buccleuch State Forest. Of the non-threatened species, only *P. bibronii*, *Uperoleia laevigata* and *Litoria latopalmata* appeared restricted in range or abundance with the record of *L. latopalmata* being a range extension (Lemckert *et al.* 1995).

The survey located numerous slow-moving, or still, permanent water bodies scattered through the study area. Such habitats (in the

Table 2. Frogs located during the survey of the Tumut/Tumbarumba Area.

Species name	Common name	Number of sites	Numbers of adults located
Crinia signifera	Common Eastern Froglet	68	>1000
Crinia parinsignifera	Plains Froglet	61	>1000
Limnodynastes tasmaniensis	Spotted Grass Frog	56	>1000
Limnodynastes dumerilii	Banjo Frog	38	300–600
Pseudophryne bibronii	Brown Toadlet	1	5–10
Pseudophryne corroboree	Corroboree Frog	2	4
Pseudophryne dendyii	Dandy's Toadlet	4	>100
Uperoleia laevigata	Smooth Toadlet	3	10–20
Litoria latopalmata	Broad-palmed Frog	1	1
Litoria peronii	Peron's Tree Frog	12	50–100
Litoria verreauxii	Whistling Tree Frog	44	>1000

form of dams, slow moving water courses and isolated billabongs) are those preferred by *Litoria aurea* and *L. raniformis* (based on Barker and Grigg 1995 and Cogger 1992) and the failure to find the two species cannot be attributed to a lack of suitable sites. Suitable boggy areas for *Pseudophryne corroboree* were also observed scattered through the highlands, but only those in Buccleuch SF contained the species. The streams surveyed for *Litoria spenceri* appeared to be unsuitable as habitat in that they were heavily covered by vegetation, few or no emergent rocks were present and the streams were relatively narrow (no more than a metre wide). This species appears to prefer fast flowing relatively wide streams which contain numerous emergent rocks on which the adults and sub-adults can rest (Gillespie 1992).

Reptiles

One species of gecko, fourteen skinks and three snakes were recorded during the surveys (Table 3). All are considered to be at least moderately common (based on Ehmann 1992). However, all were located in only small numbers during these surveys and only *Hemiergis decresiensis* and *Tiliqua nigrolutea* were located at more than two sites. Of note was the record of the threatened *Rhinoplocephalus flagellum* (little whip snake) from within the survey area three months after the surveys were completed. In this instance an adult was killed when the rock under which it was sheltering was disturbed by a plough, crushing the snake. The site was 1 km north-west of Tumbarumba (AMG 590300 6043200) and the habitat was cleared grazing land. The specimen has been lodged with the Australian Museum.

An assessment of the available habitats indicated that rock outcrops and areas of grassland potentially suitable for the two legless lizards were scattered across the study area. However, the grasslands appeared to usually be at least partly degraded by grazing and introduced grasses predominated (S. Jones, pers. comm., pers. obs.). Murraguldrie State Forest provided the most promising habitat for *Aprasia parapulchella* and Bago State Forest the best for *Delma impar*. The habitat requirements of *Varanus rosenbergi*

Table 3. Reptiles located during the survey of the Tumut/Tumbarumba Area.

Species Name	Common Name	Number of Sites
Diplodactylus vittatus	Stone Gecko	1
Ctenotus robustus	Robust Skink	2
Ctenotus taeniolatus	Copper-tailed Skink	1
Egernia cunninghami	Cunningham's Skink	2
E. saxatilis	Black Rock Skink	2
Eulamprus heatwolei	Highland Water Skink	2
Hemiergis decresiensis	Three-toed Skink	8
Lampropholis delicata	Grass Skink	3
Lampropholis guichenoti	Garden Skink	1
Morethia boulengeri	Boulenger's Skink	2
Nannoscincus maccoyi	Maccoy's Skink	2
Pseudemoia duperryii	Three-lined Skink	2
P. entrecasteauxii	Tussock Skink	2
P. spenceri	Spencer's Skink	2
Tiliqua nigrolutea	Blotched Blue-tongue	8*
Austrelaps ramsayii	Highlands Copperhead	2
Pseudechis porphyriacus	Red-bellied Black Snake	1
Pseudonaja textilis	Eastern Brown Snake	2

*More *Tiliqua nigrolutea* were reported by other surveyors and it appears to be the most widespread reptile in the area. Up to a dozen were seen dead on the roads.

appear to be general enough (based on Swan 1990 and Ehmann 1992) to be potentially found throughout the study area.

DISCUSSION

Success of surveys

In terms of locating threatened species, the success of these surveys was poor with only *Pseudophryne corroboree* being recorded out of the eight targeted species and then only in areas where this frog is regularly recorded. This result might have been influenced by the relatively dry conditions prevalent through the second and third surveys which may have reduced the chances of locating individuals as frogs, and at least *Aprasia parapulchella* are far more difficult to locate during dry conditions (S. Jones, pers. comm.). However, if this was the case, it did not appear to have effected frog activity, as all species present continued to call strongly through all three survey periods with the corroboree frog calling as actively as during the previous years of monitoring (B. Gay, pers. comm.). The results for *Delma impar* were certainly influenced by the use of visual surveys which were recognized as not ideal for this species, but were used due to time constraints (pitfall trapping is recommended for surveys of *D. impar* by Kukolic and Osborne 1993). The other species, however, should still have been active enough to locate them. Even under dry conditions the sloughed skins of *Aprasia parapulchella* can be found under rocks. Therefore, timing should not have contributed greatly to the limited success of these surveys.

Rather, such a lack of success appears typical for herpetofauna surveys in the region as indicated by the results of both Caughley and Gall (1985) and Annable (1995). In the former study a total of 52 species of frogs and reptiles were recorded (as opposed to 29 in this study) yet only *Litoria raniformis* was located during the twelve months of their survey (although they did not survey areas where *P. corroboree* is known to occur). Annable (1995) collated records or reptiles obtained over a 10 year period from the Wagga area of New South Wales (which is within and adjacent to the western edge of this study area). Thirty-eight species were recorded in this time, but despite this long time frame, and his efforts to obtain records from various local herpetologists, the study still did not make a single record of threatened reptiles potentially found in that area. The results of all three studies would indicate that threatened reptiles are rarely seen even during extensive or long-term targeted visual surveys. Thus different approaches are required when trying to consider the presence of these species in an area. Alternative survey techniques may provide a suitable solution (e.g., pitfall trapping) or conservation may more appropriately be based on an assessment of the available habitats to determine which species may be present within an area under consideration. This can then be followed by the setting of management guidelines to protect likely habitats for each species.

Threatening processes

There are explanations as to why threatened species are likely to be rare in the study area. *Delma impar* is known to prefer relatively undisturbed dense grass cover, often with a large component of native grasses (Coulson 1990; Kukolic *et al.* 1994; Ministerial Report 1994) and *Aprasia parapulchella* also appears to be associated with native grasses (Osborne and Jones 1995; Osborne *et al.* 1993). Both species also decline as the percentage of native grasses available declines (Coulson 1990; Osborne and Jones 1995). Grazing and crop production are practised extensively in the area, and this reduces the likelihood of these two species existing in anything but small isolated pockets, as is the case in the ACT for *Delma impar* (Kukolic and Osborne 1993). While areas of grassland remained widely scattered, every patch that was inspected showed cattle damage or disturbance (hoof marks, cow pats or close cropping) and so probably a reduced composition of native species. The extent to which this is likely to be a problem is demonstrated by the two recorded *Aprasia* sites from the Tarcutta area. Both are known to have been severely degraded by grazing in recent years to the point where the species is now probably extinct (S. Jones, pers. comm.; Osborne *et al.* 1993). Neither State Forests nor National Parks were seen to contain any extensive suitable grassland areas and there should be concern over the long-term conservation of both species.

Clearing of native vegetation for agriculture may also represent an on-going problem. *Rhinoplocephalus flagellum* requires surface rocks and wooded areas (Ehmann 1992), both of which are removed for crop production and pasture improvement (e.g., the snake killed near Tumbarumba) or disturbed and trampled by grazing animals. Again, halting the clearing of native vegetation would be the first step in the conservation of this species followed by the management of areas of habitat in which the species is likely to be present.

For the frogs, the long-term future of the *Pseudophryne corroboree* in the area should be secure with the State Forests of NSW implementing a management plan to protect the relatively large populations of this species found within Buccleuch State Forest. Burning regimes are to be controlled so that fire is not used in areas when frogs are congregated around breeding sites and logging is to be kept out of breeding swamps through the use of buffer zones which are also designed to protect the water quality of bogs (B. Gay, pers. comm.). Of most concern are the impacts of grazing on the breeding habitat of the frog (B. Gay, pers. comm.). This appears to be the most serious threat during periods of drought as the cattle do congregate in swamps where the best green vegetation remains (pers. obs.). This could affect the frogs by changing the hydrological regimes of the swamps, destroying the vegetation cover used for shelter or by direct trampling of the frogs and their eggs. This may not be a serious effect as monitoring of breeding sites before and during the dry periods experienced during this study indicated the frogs called as strongly as in previous years and were producing clutches of eggs just as successfully (B. Gay, pers. comm.). However, there is no pre-cattle information on frogs numbers to demonstrate that there has not already been a change and longer term monitoring of these sites is required to look for more subtle changes between years. Preferably, an experimental study should be carried out comparing mortality and reproductive success between populations in grazed and ungrazed swamps or sections of swamps to specifically determine the impacts of cattle. At this point in time it would be appropriate to exclude cattle from swamps as far as possible on the basis of the precautionary principle.

The status of the species of bell frogs present within the region remains uncertain. Three species were apparently once common throughout the southern highlands (Thomson *et al.* 1996), but disappeared during the late 1970s and early 1980s (White and Pyke 1996; Osborne *et al.* 1996) for reasons which remain unclear. Introduced fish, viruses and increased UV radiation are some of the suggested possible causes of the decline, but conclusive proof is not yet available for any one factor to have been responsible (Osborne *et al.* 1996). *Litoria raniformis* is still common further along the Murray Valley (H. Ehmann, pers. comm.) and so this species may be able to recover.

Conservation of the region's herpetofauna

Firstly, it would be most beneficial if further surveys for the grassland species of reptiles could be carried out to determine if and where the species remain present within the region. The few available records for both *Delma impar* (Canberra, Cooma, Yass and Batlow; Kukolic and Osborne 1993; Osborne *et al.* 1993) and *Aprasia parapulchella* (Canberra, Adelong, Tarcutta and Bathurst; Osborne and Jones 1995) are widely scattered. This suggests that they could remain present almost anywhere there is suitable habitat. Any such confirmed locations could then be considered in a regional management plan and certainly should receive some form of reservation.

All the threatened species of reptiles known from the study area require open grasslands and/or woodlands rather that more heavily forested areas. Therefore, in the longer term grazing and clearing on private lands is probably the greatest concern with a continuous low-level impact altering the composition of grasses from native to introduced species (W. Osborne and S. Jones, pers. comm.). The main conservation requirement for the area is reservation of native grassland/woodland in which the above two species and *Rhinoplocephalus flagellum* are found or can be re-introduced. In addition, the cessation of the clearing of native vegetation also appears to be very important to ensure that any undiscovered remnant populations are protected. Logging operations are unlikely to affect these reptiles as they would only be found in the more open woodlands and these are now rarely logged (B. Gay, pers. comm.). Of more interest from a forestry perspective is the continued grazing of timber lands and hazard reduction burning to control bush fires. Preferably, grazing of State Forests should be phased out in areas of open woodland with a naturally grass-dominated understorey. Burning should as far as possible be excluded from any known threatened reptile site as it will destroy the grasses with which *Aprasia* and *Delma* are associated and the woody debris under which *Rhinoplocephalus* shelters. The controlled burning regime should also be designed to form a mosaic of unburnt, old-burnt and recently burnt areas and thus provide a variety of fauna habitats.

It would appear most unlikely that *Varanus rosenbergi* is present in the study area. Annable (1995) considers that it is unlikely to have ever been present around Wagga and it would also appear unlikely that it occurred within the boundaries of this study area. However, the disjunct but scattered nature of the populations of this species would suggest that it could potentially be present. Until its presence can be confirmed, the most important conservation step would appear be the retention of the remaining natural vegetation to provide refuge habitats.

The conservation of the threatened frog species is more straight-forward (at least at present). The spotted tree frog again appears unlikely to occur within the bounds of the study area as suitable habitat was not located. However, the species may possibly be present close by within the boundaries of Kosciuzko National Park and further surveys would be helpful to delineate its current distribution within New South Wales. *Pseudophryne corroboree* is currently being managed by State Forests of NSW (in conjunction with other bodies such as the NSWNPWS) to maintain the species within Buccleuch State Forest and so its future should be more secure. The conservation of the bell frogs requires that the causes of the noted declines be determined so that they can return to previously inhabited areas. Research is currently underway to look at several suggested causes (e.g., feral fish such as *Gambusia* sp. and increased UV radiation) and if a specific cause can be determined both *Litoria raniformis* and *Litoria aurea* should be able to recolonize previously inhabited areas. The challenge is for the various landholders within the region to come up with a management plan for the remnant natural vegetation of the region which appears critical to the continued existence of the threatened herpetofauna found there.

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BOOK REVIEWS — BOOK REVIEWS

Exploring Central Australia: Society, the Environment and the 1894 Horn Expedition by S. R. Morton and D. J. Mulvaney.
Published by Surrey Beatty & Sons, 1996.
400+ pp. RRP $85. ISBN 0 949324 67 1.

As the title suggests, this book focuses on the Horn Scientific Expedition to central Australia in 1894. The Expedition set out to investigate the natural environment and the anthropology of the local indigenous peoples in and around the MacDonnell Ranges. Unlike other expeditions of the time, the Horn Expedition was devoted almost entirely to scientific investigation. A wealth of written material, including reports, diaries, narratives and correspondence, emanated from the expedition. The *Report of the Horn Expedition*, published in four volumes, is perhaps the most significant legacy of the Expedition. It is this extensive literature that stands the Horn Expedition apart from other exploratory expeditions of the time.

To celebrate the centenary of the Expedition, a small group of historians, scientists and anthropologists in Alice Springs determined, as a Committee, to publish a facsimile of the Report of the Horn Expedition and to hold a symposium to re-examine various aspects of the expedition's findings. This book presents the proceedings of that symposium, held at Alice Springs in September 1994. The brief given to contributors to the symposium was to "reinvestigate the contribution made to knowledge of the environment and people of central Australia, to re-examine that knowledge in the light of current understanding of the environment and cultures of the region, and to explore changes that have taken place in the landscape and human society in the past century".

The 27 papers in this book, arranged as chapters, cover many aspects of the natural and cultural history of central Australia including prehistory, history, anthropology, biology, ecology, Aboriginal culture, and social commentary. Some authors address the findings of the expedition directly, others present works that are more peripheral. Collectively, the authors illustrate how important the expedition has been to our current understanding of the region's natural environment and peoples, both in terms of advancing our knowledge and retarding it. The Expedition provided the impetus for many subsequent collections and studies. The information gathered provided a benchmark from which subsequent changes in the region can be assessed. The ability to look back 100 years and reflect on the past is a sobering experience, but a powerful tool for setting goals into the next century.

I found some papers much more compelling than others, but this probably reflects my own personal interests rather than any difference in the quality of writing. The book certainly enhanced my knowledge of central Australia, but it also gave me a greater appreciation of how instrumental the Horn Expedition was in formulating this knowledge and in influencing current thinking. I was fascinated by the extent to which the Expedition had contributed to the role that science played in shaping Australia's national imagery.

The most compelling aspect of the book for me, however, was the insight it provided into late nineteenth century issues, prejudices and understanding of science and the natural environment. The snippets of Aboriginal knowledge dotted throughout the book were particularly fascinating, as were the descriptions of the Aboriginal people and their customs viewed through the eyes and prejudices of the expeditioners. It is unfortunate that the conventional attitudes of the time stifled the collection of this kind of information.

Although each chapter stands alone as a separate paper, the amount of duplication or repetition is surprisingly minimal. Like most proceedings of this kind not all papers will interest all readers, but for those readers with a keen interest in the natural and social environment of central Australia this book offers plenty. I applaud members of the Centenary Committee for their achievement in publishing the facsimile of the Report of the Horn Expedition and for their vision to hold the symposium. I congratulate the editors on their production of the proceedings, and I recommend the book to anyone with an interest in the heart and soul of this great land.

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